

***Collocherides brychius*, a new species (Copepoda: Siphonostomatoida: Asterocheridae) from a deep-water hydrothermal site in the northeastern Pacific**

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Abstract.—*Collocherides brychius* is described from a depth of 2253 m at a hydrothermal site on the Juan de Fuca Ridge in the northeastern Pacific. The species is close to *C. astroboae* Stock 1971, but may be distinguished from that species by its relatively small size (length of female 0.57 mm) and by the inner terminal seta on the caudal ramus of the female being approximately as long as the caudal ramus, instead of more than 3 times its length. Although its three congeners are associated with ophiuroid echinoderms in shallow water, the new species was recovered free in microfaunal samples in the deep sea.

The copepod genus *Collocherides* Stock 1971 (Siphonostomatoida: Asterocheridae), contains three species. *Collocherides astroboae* Stock 1971, lives in the stomach of the basket star *Astroboa nuda* (Lyman) at Eilat in the Gulf of Aqaba and at the Dahlak Archipelago (depth about 50 cm) in the Red Sea (Stock 1971). It has also been recovered from the stomach of *Astroboa albatrossi* Döderlein in Indonesia (precise locality unknown but probably Java Sea) (Stock 1971). Large numbers of *C. astroboae* were found on *A. nuda* in 18 m at Nosy Bé, northwestern Madagascar (Humes 1973). *Collocherides singularis* Humes 1986, lives with *Astroboa nuda* (depth 5 m) at Poelau Gomumu, Moluccas, 01°50'00"S, 127°30'54"E (Humes 1986). *Collocherides bleptus* Humes 1993, occurs intertidally on the ophiuroid *Macrophiothrix* sp. at Nosy Bé, northwestern Madagascar (Humes 1993).

Sixty-seven species of copepods have been recorded in deep water from hydrothermal vents and cold seeps in the world's oceans (Humes & Segonzac 1998). These species consist for the most part of siphonostomatoids, with fewer calanoids, miso-

phrioids, cyclopoids, poecilostomatoids, and harpacticoids. In this paper a new species of the siphonostomatoid genus *Collocherides* is described from a deep-water hydrothermal site in the northwestern Pacific. With the addition of this new species, a new erebonasterid poecilostomatoid reported by Martinez Arbizu (1999), and a new aegisthid harpacticoid described by Conroy-Dalton & Huys (1999), the number of copepods known from deep-sea hydrothermal vents and cold seeps rises to 70.

Materials and Methods

The copepods were collected at a low temperature vent, where the highest reading was 52° Celcius. The vent (Marker M) was situated on new lava flows, and is believed to be relatively young. (Vents at older mature lavas are believed to support more heterogeneous faunas, with more species, than young vents (Milligan & Tunnicliffe 1994).) The diving submersible *Alvin* used its arm or "claw" to gather tube worms (Vestimentifera) and associated fauna and deposit them in a biobox mounted on a basket. The sample was preserved for later

sorting, during which copepods were recovered (Tsurumi, pers. comm.).

The copepods, which had been preserved in ethanol, were cleared and dissections made in lactic acid, using the wooden slide method described by Humes & Gooding (1964). All figures were drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn.

Siphonostomatoida Thorell, 1859

Asterocheridae Giesbrecht, 1899

Collocherides Stock, 1971

Collocherides brychius, new species

Figs. 1–3

Type material.—9 ♀♀, 3 ♂♂, in 2253 m, Juan de Fuca Ridge, Segment Cleft, North Field, Vent Marker M, northeastern Pacific, 44°58.97'N, 130°12.35'W, 28 Aug 1990. Holotype ♀ (USNM 243645), allotype ♂ (USNM 243646), and 6 paratypes (5 ♀♀, 1 ♂) (USNM 243647) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Remaining specimens (dissected) in the collection of the author.

Female.—Body slender (Fig. 1a), not flexed between prosome and urosome (Fig. 1b). Average length (not including setae on caudal rami) 0.57 mm (0.55–0.58 mm) and average width 0.18 mm (0.17–0.19 mm), based on 9 specimens. Dorsoventral thickness (at level of slight protuberance between maxillipeds and first pair of legs) 127 μm. Epimera of metasomal somites rounded (Fig. 1b). Ratio of length to width of prosome 2.03:1. Ratio of length of prosome to that of urosome 1.31:1.

Urosome with 5 somites. Somite bearing leg 5 (Fig. 1c) 47 × 83 μm. Genital double-somite in dorsal view 81 μm long and 81 μm wide at widest part. In lateral view (Fig. 1d), this double-somite with dorsal and ventral sides slightly rounded. Genital areas located laterally in anterior half of double-somite (Fig. 1c, d). Each genital area with small seta and minute spine (Fig. 1d). Three

postgenital somites from anterior to posterior 36 × 53, 31 × 40, and 23 × 36 μm. Genital double-somite and 3 postgenital somites with pairs of small posterolateral spinelike processes or spinules (Fig. 1d, e), those on anal somite prominent.

Caudal ramus (Fig. 1e) moderately elongate, unornamented, length including terminal pointed process 44 μm, length without process 35 μm, width 16 μm. Ratio of length (without process) to width 2.19:1, ratio including process 2.75:1. With 6 smooth setae, 1 long and 5 short, longest seta 52 μm long, much longer than other setae and slightly swollen proximally. Long seta slightly longer than ramus, ratio 1.18:1.

Body surface with few sensilla on urosome, otherwise unornamented.

Egg sac (Fig. 1d), seen on only 1 female, large, oval, 179 × 99 μm.

Rostral area (Fig. 1f) triangular, not protruding. Antennule (Fig. 2a) 20-segmented, 187 μm long, with aesthetasc 60 μm long on segment 18. Formula for armature: 1, 2, 2, 2, 2, 2, 2, 6, 2, 2, 2, 2, 2, 2, 2, 2+1 aesthetasc, 2, and 9. All setae smooth. Antenna (Fig. 2b) 99 μm long, including terminal spine 22 μm. First segment (coxa) short and unarmed. Second segment (basis) with 1 minute seta (exopod). Third segment long and unarmed. Short fourth segment bearing 2 short setae and 1 long terminal spine, its truncated tip with few extremely minute setules.

Oral cone (Fig. 1f) short, oval in ventral view, prominent in lateral view (Fig. 1b).

Mandible (Fig. 2c) with slender 2-jointed palp 60 μm long. Gnathobase (Fig. 2d) 50 μm long., with several blunt terminal teeth. Maxillule (Fig. 2e) with 1 seta on slender outer lobe and 4 setae on stout inner lobe. Maxilla (Fig. 2f) 2-segmented, first segment unarmed, second segment bearing recurved claw with truncated minutely spinulose tip. Maxilliped (Fig. 2g) 5-segmented. First segment with inner distal seta. Second segment elongate (52 μm long) with 1 seta on inner margin. Third and fourth segments short with 1 seta. Fifth segment elongate

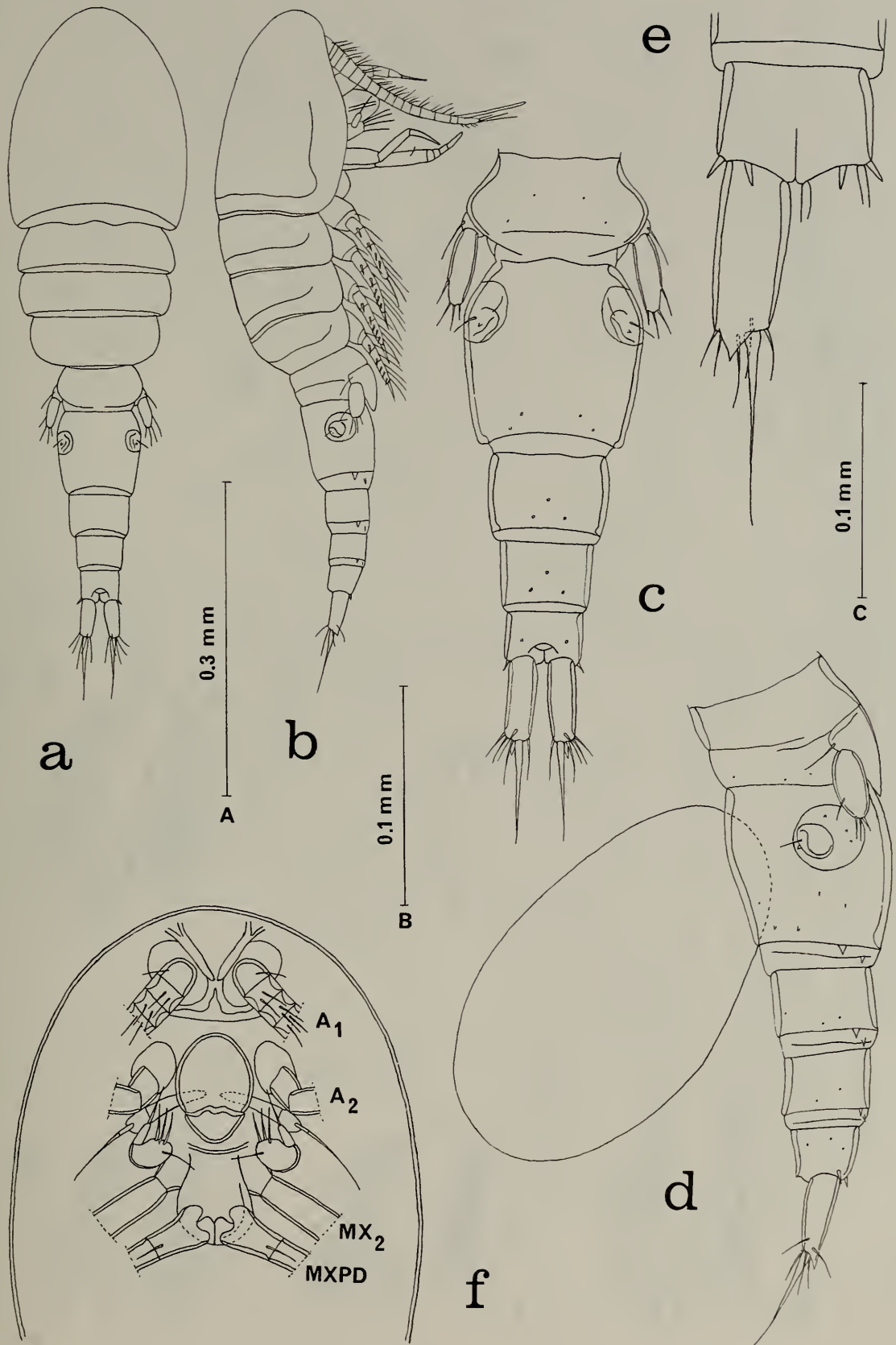


Fig. 1. *Collocherides brychius*, new species. Female. a, body, dorsal (scale A); b, body, lateral (A); c, urosome, dorsal (B); d, urosome, lateral (B); e, anal somite and caudal ramus, ventral (C); f, cephalosome, ventral (B).

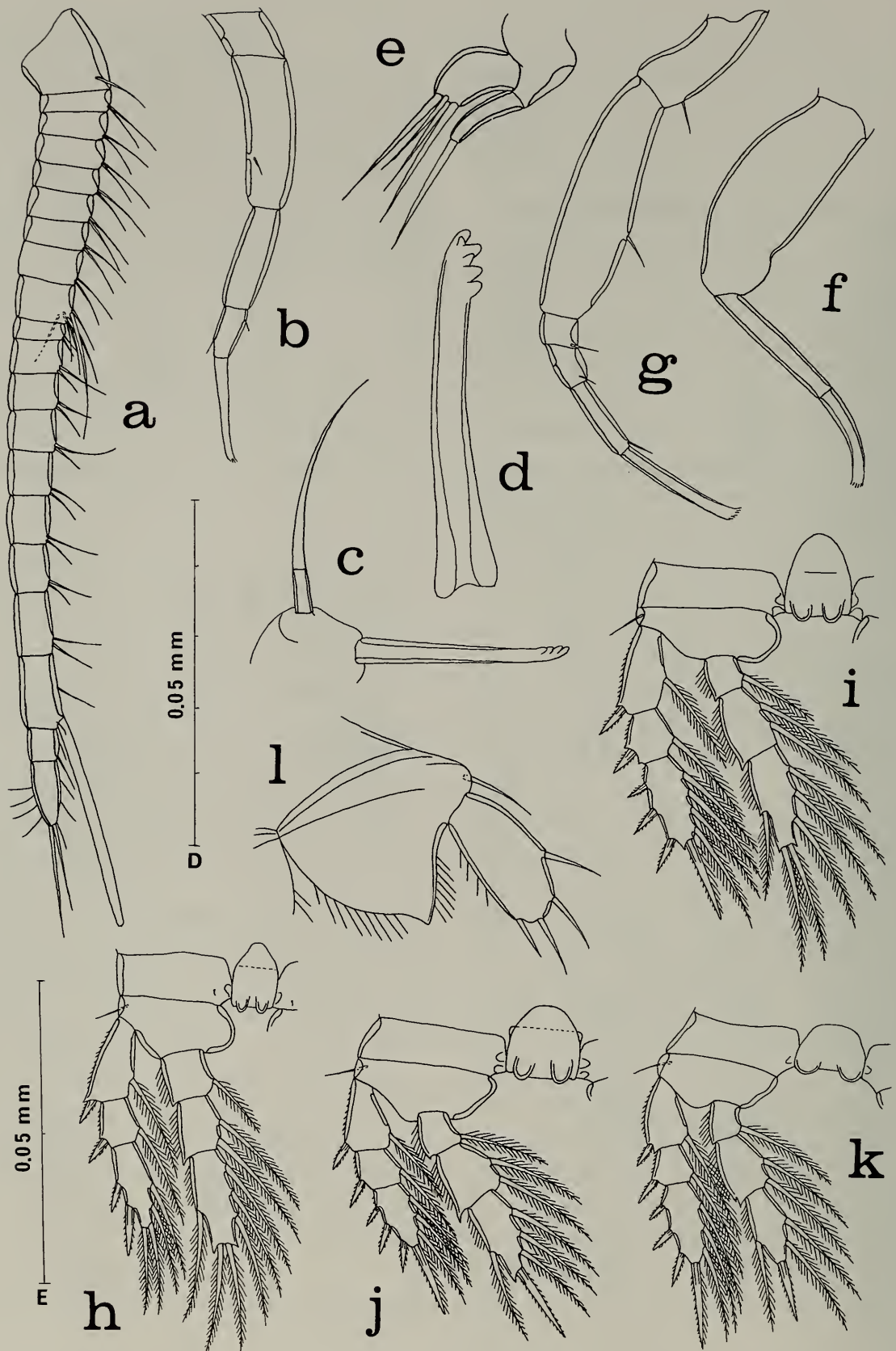


Fig. 2. *Collocherides brychius*, new species. Female. a, antennule, ventral (scale C); b, antenna, dorsal (C); c, mandible, ventral (C); d, gnathobase of mandible, flat view (D); e, maxillule, anterior (C); f, maxilla, posterior (C); g, maxilliped, posterior (C); h, leg 1 and intercoxal plate (E); i, leg 2 and intercoxal plate, posterior (E); j, leg 3 and intercoxal plate, anterior (E); k, leg 4 and intercoxal plate, anterior (E); l, leg 5, ventral (C).

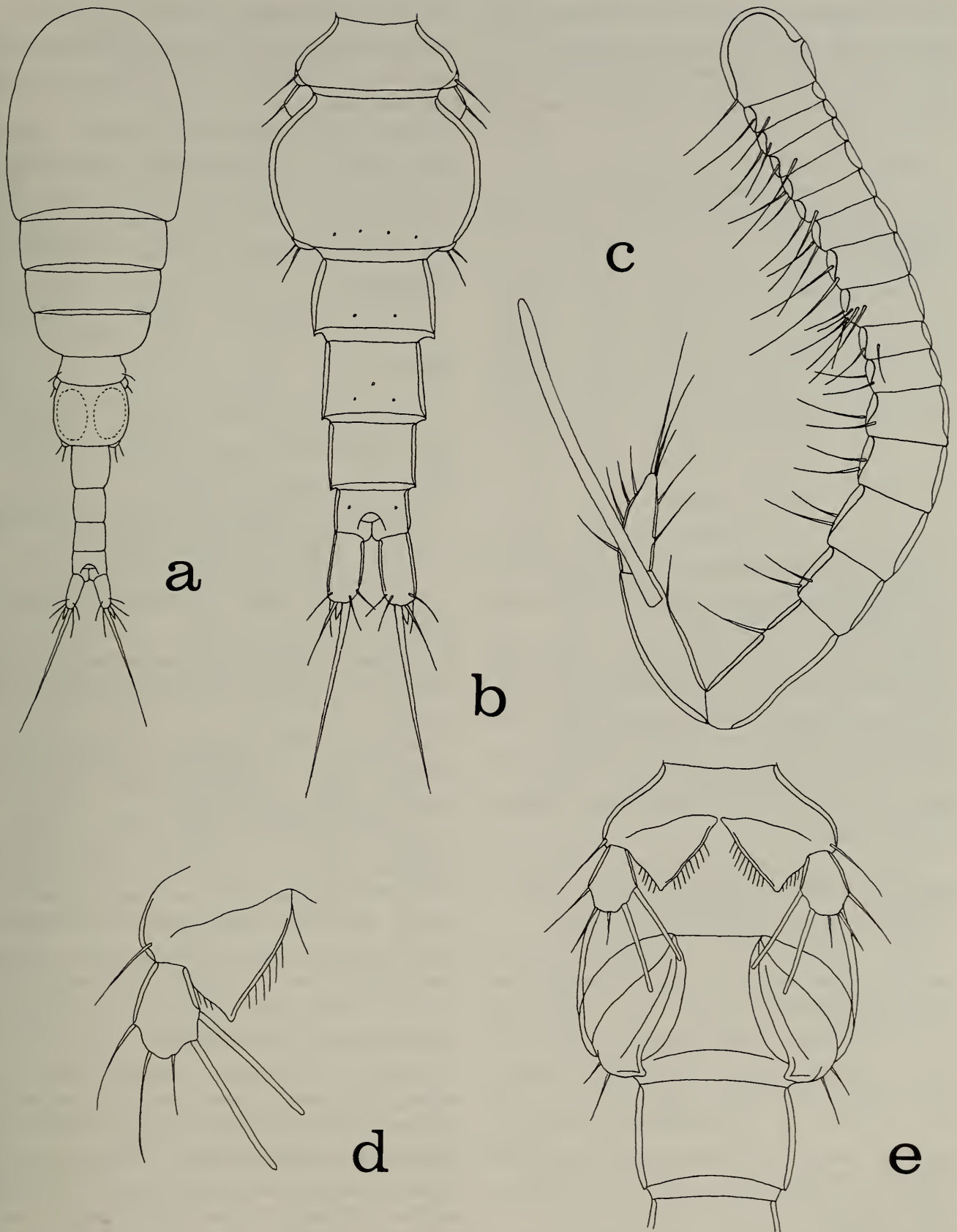


Fig. 3. *Collocherides brychius*, new species. Male. a, body, dorsal (scale A); b, urosome, dorsal (B); c, antennule, ventral (C); d, leg 5, ventral (C); e, somites 1–3 of urosome, showing legs 5 and 6, ventral (E).

with 1 distal seta. Claw (26 μm long) with truncated tip bearing minute spinules.

Ventral area between maxillipeds and first pair of legs (Fig. 1f) slightly protuberant (Fig. 1b).

Legs 1–4 (Fig. 2h–k) biramous with 3-segmented rami. Formula for spines (Roman numerals) and setae (Arabic numerals) as follows:

P_1	coxa 0-0	basis 1-0	exp I-1;	I-1;	II, 2, 2
			enp 0-1;	0-2;	1, 2, 3
P_2	coxa 0-0	basis 1-0	exp I-1;	I-1;	III, I, 4
			enp 0-1;	0-2;	1, 2, 3
P_3	coxa 0-0	basis 1-0	exp I-1;	I-1;	III, I, 3
			enp 0-1;	0-2;	1, I, 3
P_4	coxa 0-0	basis 1-0	exp I-1;	I-1;	III, I, 3
			enp 0-1	0-2,	1, I, 2

Inner coxal seta absent in all 4 legs. Outer margins of exopod segments of all 4 legs with very small spinules.

Leg 5 (Fig. 2l) 2-segmented. First segment with outer seta and produced medially as broad triangular flap, pointed at tip, and having inner and outer setules. Second segment $31 \times 14 \mu\text{m}$, ratio 2.2:1, bearing 4 setae and ornamented along inner margin with few setules.

Leg 6 represented by seta and small spiniform process on genital area (Fig. 1d)

Color of living specimens unknown.

Male.—Body (Fig. 3a) elongate, slender, and, as in female, not flexed. Length (not including setae on caudal rami) 0.50 mm (0.50–0.51 mm) and greatest width 0.15 mm (0.15–0.16 mm), based on 3 specimens. Greatest dorsoventral thickness at level of small ventral protuberance 96 μm . Ratio of length to width of prosome 1.98:1. Ratio of length of prosome to that of urosome 1.36:1.

Urosome (Fig. 3b) with 6 somites. Somite bearing leg 5 $32 \times 70 \mu\text{m}$. Genital somite $60 \times 83 \mu\text{m}$, with rounded lateral margins. Four postgenital somites from anterior to posterior 34×49 , 32×39 , 26×32 , and $21 \times 31 \mu\text{m}$.

Caudal ramus similar to that of female,

$37 \times 15 \mu\text{m}$ including terminal process. Inner terminal seta 143 μm long, relatively much longer than in female, 3.86 times longer than ramus.

Rostral area like that of female. Antennule (Fig. 3c) 18-segmented, geniculate. Aesthetasc on segment 17 59 μm long. Armature: 1, 2, 2, 2, 2, 2, 2, 2, 6, 2, 2, 2, 2, 2, 2, 1, 1 + aesthetasc, and 9. Antenna as in female.

Oral cone, mandible, maxillule, maxilla, maxilliped, and legs 1–4 like those of female.

Leg 5 (Fig. 3d) with second segment $20 \times 12 \mu\text{m}$, ratio 1.67:1, bearing 3 slender outer setae and 2 broad, hyaline, inner setae, 33 μm , with blunt tips.

Leg 6 (Fig. 3e) usual posteroventral flap on genital somite bearing 2 setae.

Color of living specimens unknown.

Etymology.—The specific name *brychius*, from Greek *brychios*, meaning from the depths of the sea, refers to the depth at which specimens of the new species was found.

Remarks.—The female of *Collocherides brychius* may be differentiated from its three congeners as follows:

From *C. astroboae* Stock 1971, in which the long terminal seta on the caudal ramus is approximately 3.6 times longer than the ramus, and the body length is 0.62 mm (measurements based on an average of five specimens from *Astroboa nuda* from the Dahlak Archipelago (Zoölogisch Museum Amsterdam, cat. no. 101.090).

From *C. singularis* Humes, 1986, in which the caudal ramus lacks a terminal process, the long terminal seta on the caudal ramus is approximately 1.8 times longer than the ramus, the second segment of the endopod of legs 1–3 has one inner seta, and the average body length is 0.64 mm.

From *C. bleptus* Humes, 1993, in which the ratio of the innermost terminal seta on the caudal ramus to the length of the ramus itself is approximately 2.51:1, the genital double-somite is $120 \times 80 \mu\text{m}$, distinctly longer than wide, the average body length

is 0.77 mm, and the ventral surfaces of the genital and postgenital somites have numerous small scalelike spines.

In *C. brychius* sexual dimorphism occurs in the length of the inner terminal seta on the caudal ramus, which in the female is 42 μm , but in the male is 143 μm and less swollen proximally than in the female.

The four species of *Collocherides* may be further distinguished by the following key.

Key to females of the genus *Collocherides*

1. Genital double-somite distinctly longer than wide, ratio 1.4:1; body length 0.77 mm (0.75–0.78 mm) *C. bleptus*
Genital double-somite quadrate or nearly so, ratio approximately 1:1; body length not exceeding 0.67 mm 2
2. Long inner terminal seta on caudal ramus 3.6 times longer than ramus
. *C. astroboae*
Longest seta on caudal ramus 1.18 times (or less) longer than ramus 3
3. Body length 0.57 mm (0.55–0.58 mm); legs 1–3 with second segment of endopod having 2 inner setae *C. brychius*
Body length 0.64 mm (0.63–0.65 mm); legs 1–3 with second segment of endopod with 1 inner seta *C. singularis*

The ecological and host relationships within the genus *Collocherides* are poorly known. *Collocherides astroboae*, *C. singularis*, and *C. bleptus* are associated with shallow-water ophiuroids, while *C. brychius* lives in deep-water hydrothermal sites and was recovered free in meiofaunal samples. However, much more information is needed to understand these relationships. The possibility that there may have been ophiuroids at the deep-sea vent site cannot be excluded. Ophiuroids, known from abyssal depths (e.g., Lauermann and Kaufman 1998), have been reported from deep-sea hydrothermal sites (Hessler and Smithey 1983; Grassle 1986; Tunnicliffe 1991, 1998; Segonzac 1992; Sibuet & Olu 1998). A new genus and species of ophiuroid, *Ophioctenella acies*, was described from

the Mid-Atlantic Ridge by Tyler et al. (1995). However, no ophiuroids are yet known from Juan de Fuca vents, where the *C. brychius* was found (Tunnicliffe, pers. comm.).

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